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Global Issues

Grade 9

Chapter 4 – Harvesting the Wind

*What is wind?*

* A form of the sun’s energy
* Parts of the planet receive direct sunlight
* Difference in air temperatures create large planetary flows of wind
* Air above land heats up faster during the day and cools more quickly at night than does the air above the ocean
* Mountains impact altitude, thus temperature of the air
* When air near the surface is hot, it expands and rises, creating a pressure vacuum into which cooler air rushes
* Oceans and continents, mountains and the passes between them, hulls and valleys, deserts and forests help us predict wind patterns
* Places where winds average more than 15 miles per hour which is necessary for efficient production of electricity, is where windmills are placed

*The fastest-growing form of renewable energy*

* Earths wind resource is big enough to provide five times the total amount of energy consumed by the entire world from resources
* Wind power available in the US could technically provide 10 times the amount of electricity the country consumes annually
* Wind power has been the greatest source of increased electricity-generating in the US
* Also the fastest growing source of any form of energy, surpassing the net additional capacity from coal fired, gas fired, and nuclear power plants combined.
* US led the world in the installation of new wind capacity in 2008
* Wind power also has the lowest cost of any form of renewable energy other than geothermal
* As the world moves towards putting a price on carbon to establish a more realistic valuation of fossil fuel-generated electricity, wind is positioned to continue its rapid growth as a major source of electricity for the world

*How a wind turbine works*

* Towers with three blades on a horizontal axis. The rotor and electrical generator are at the top of the tower, and a computer controlled motor points the blades into the wind. The curved shape of each blade increases wind velocity above it, which decreases air density. This low pressure creates aerodynamic lift, which pulls the blade, causing it to rotate. The rotation of the blades spins a driveshaft, which turns the electric generator, located directly behind the blades.

*Modern Windmills and Wind Farms*

* Commercial sized windmills have blades 89 to 147 feet long mounted atop a tower 147 to 344 feet tall.
* The most popular turbine engine produces on average 1.5 megawatts of electricity, which is enough to supply the electricity needed by 400 average homes.
* Large windmills are occasionally installed in clusters of dozens or hundreds in utility scale “wind farms” connected to the transmission and distribution grid
* Modern windmill blades are designed similarly to the ones used in airplane wings
* The rotation of the blades spins a driveshaft that turns an electric generator to produce electricity in much the same way that steam drives the blades of the much larger turbines in fossil fuel, nuclear, and concentrated solar thermal plants
* Taller and larger rotors created have improved efficiencies
* Disadvantages are the difficulty of transporting the large blades on highways
* Since towers blades and turbines cost money to transport over long distances, there is an emerging cost advantage to building windmills in the country where they are used.
* The manufacturing and installation of windmills has created several jobs for many in the US
* Wind power unlike many other technologies does not require water which is and increasingly important advantage in dry regions
* Windmills are durable over a long period of time
* Uses less land than any other renewable-energy option, but it is the most visible on the horizon

*Offshore Windmills*

* The use of offshore wind is growing rapidly for several reasons.
* Fewer objections to the siting of windmills offshore
* Winds are generally stronger, more predictable, and less turbulent over the ocean, because the surface is flat with few obstructions
* Transmission cables buried under the ocean bottom to carry the electricity to shore are relatively inexpensive
* Denmark, Sweden, the United Kingdom, Ireland, the Netherlands, and China are all beginning to use offshore wind as an attractive source of renewable, pollution –free electricity

*Leaders in Wind*

* Texas is associated with the production of energy from oil
* They are the leaders in installed wind capacity, with more than twice as much as any other state
* Iowa, and California are second and third
* Minnesota is fourth as it leads all states percentages of its overall electricity that comes from wind
* Twenty-two states currently have more than 100 megawatts of installed electricity production from windmills (enough to supply 30,00 homes)
* World’s largest onshore wind farm is in Texas, west of Dallas
* The Horse Hollow Wind Energy Centre (owned by Florida Power and Light) has 421 giant turbines delivering 735 megawatts of peak power.
* Minnesota, Iowa, and Colorado get more than 5 percent of their electricity from windmills

*Limitations*

* With both wind and solar power, once everything is set, fuel is free
* Limitations on the use of wind is similar to that of solar power
* When there is no wind to turn the turbines there is no electricity
* \*Intermittency is a particular problem for both wind and \*photovoltaic energy because no heat is produced in either only electricity
* Electricity is difficult to store efficiently
* The best resources for sun and wind are generally found in areas distant from population centres
* New high technology, long distance transmission lines are needed to maximize the use of both resources

*Thinking Small*

* Several interests in making smaller windmills that can provide electricity for homes, farms, and ranches
* Estimated 13 million homes that are suitable for these small windmills all of which are in rural areas in the United States
* Urban environments do not have wind patterns suitable for wind-mills
* Wind power like photovoltaic solar cells are adaptable to what is called “distributed energy” approach, allowing those who use it to sharply reduce the electricity they purchase from utilities
* At present, 10 000 small windmills are being installed each year in the United States, and that number is rapidly increasing

**Definitions (\*):**

* *Intermittency* - intermittence: the quality of being intermittent; subject to interruption or periodic stopping.
* *Photovoltaic* - Relating to the production of electric current at the junction of two substances exposed to light.